Nonlinear coherent steering of heat and work

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In recent years we have examined a variety of generic quantum mechanical mechanisms that may allegedly boost the performance of heat machines (HM): qubit coupling to thermal or squeezed baths, a quantized oscillator piston and cooperative multi-qubit working media based on extensions of the Dicke model [1-4] and high-efficiency HM via quantum homodyne measurements [5]. Yet, we have found that genuine quantum boost exists only when QED affects the system-bath coupling [6,7]. More importantly, all existing HM, including those that present a quantum boost, are dissipative open systems, which cannot exhibit purely quantum behavior. We have now broken away from the established thermodynamic paradigm, replacing conventional HM by fully coherent nonlinear devices based on few modes whose thermal-state input is autonomously steered to a chosen mode and/or is partly transformed into work [8]. This fundamentally new principle of operation allows the bridging of quantum coherent and thermodynamic descriptions.

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